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Keksinnön nimitys
Title of invention

"Signalling in a Telecommunications System"
(Signalointi telekommunikaatiojärjestelmässä)

Hakemus on hakemusdiaariin 22.10.98 tehdyn merkinnän mukaan siirtynyt TELEFONAKTIEBOLAGET L M ERICSSON nimiselle yhtiölle, Stockholm, Sweden.

The application has according to an entry made in the register of patent applications on 22.10.98 been assigned to TELEFONAKTIEBOLAGET L M ERICSSON, Stockholm, Sweden.

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Signalling in a Telecommunications System

Field of the Invention

The present invention relates to signalling in a telecommunications system and in particular, though not necessarily, to the transmission of signalling data associated with voice or data calls.

Background to the Invention

In a telecommunications system, signalling equipment and signalling channels are required for the exchange of information between system elements or nodes. In particular, this internode signalling informs the nodes of what is to be performed when a telephone or data call is to be set up or released in so-called "circuit-switched" connections. Modern telecommunications systems now largely make use of Common Channel Signalling (CCS) whereby signalling information is transmitted on one or more dedicated signalling channels, distinct from the channels used to carry actual user information (e.g. voice or data). An important feature of CCS is that the same signalling system may support services in a variety of existing telecommunications protocols, e.g. Public Switched Telephone Network (PSTN), Integrated Services Digital Network (ISDN), and Public Land Mobile Networks (PLMN), as well as proposed future protocols such as B-ISDN, enhancing greatly the interoperability of networks supporting different protocols.

Currently, the predominant CCS is known as Signalling System Number 7 (SS7), defined in the ITU-T (International Telecommunications Union - Technical) recommendations starting with Q.700. SS7 is a packet

switched system occupying one time slot per frame of the Time Division Multiple Access (TDMA) E.1 or T.1 transmission formats (the other time slots being available for user data). Individual signalling message packets (datagrams) are associated with respective individual telephone calls. As only a relatively small amount of signalling information is associated with a single telephone call, a single SS7 channel is able to handle all signalling between two network nodes (termed "signalling points") for several thousands of calls. It is noted that the route taken by a signalling message in the SS7 network may be the same as that over which the associated telephone call is established, or it may be different.

As already noted, SS7 (along with other CCS systems) is able to support a number of different telecommunications protocols (e.g. PSTN, ISDN, PLMN). In signal processing terms, SS7 comprises a Message Transfer Part (MTP) which deals with the physical transfer of signalling information over the signalling network, i.e. message formatting, error detection and correction, etc, and user parts and application parts which allow several "users" (i.e. ISDN User Part, Telephony User Part, etc) to send signals in the same signalling network.

SS7 makes use of addresses known as Point Codes to route signalling data through the "visibility area" of a telecommunications network, the visibility area typically being the network itself together with the interfaces between the network and "foreign" networks under the control of other operators. A Point Code is placed in the header of a signalling packet and is examined by a network signalling point (SP) upon receipt of the packet to determine the next hop for the packet *en route* to its destination.

In an SS7 network, any change in the Point Code allocation within the visibility area requires the operator to update the Point Code database (or routing table) which exists in each SP of the network. This however adds significantly to the maintenance overheads of the network. The dedicated nature of SS7 makes it in general expensive to install and maintain (in relation to both hardware and software), a significant barrier especially to prospective new telecom operators. Furthermore, as an SS7 network occupies bandwidth on TDMA frames of the E.1/T.1 transmission protocols (one slot per time frame), the bandwidth available for actual user call data is restricted. Yet another disadvantage of traditional signalling architectures is that the interoperability of SS7 networks is limited due to the dedicated nature of the MTP physical layers.

Summary of the Present Invention

It is an object of the present invention to overcome or at least mitigate the above noted disadvantages of existing telecommunication signalling systems.

According to a first aspect of the present invention there is provided a method of transmitting signalling information between signalling points of a telecommunications system, said signalling information being associated with a subscriber-to-subscriber voice or data traffic channel carried by a first transmission network, the method comprising transmitting signalling information between said signalling points via a IP based network which is separate from said first transmission network.

Embodiments of the present invention enable the separation of information for transmission through the

system into call information and signalling information. The use of the IP based network for transmitting signalling information releases capacity in the originating system for use by call information. In addition, the use of the IP network reduces the need for conventional signalling infrastructure (although this may still be used in part). IP based networks offer increased flexibility (e.g. routers of the network have self-updating routing tables) and reduced operating, maintaining, and engineering costs in comparison with conventional telecommunications signalling networks.

Preferably, said first transmission network is a circuit switched network, using for example PSTN, ISDN, or PLMN protocols, or a combination of these protocols.

Preferably, said signalling points between which the user call information and the signalling information is transmitted are switching points (e.g. exchanges) of the telecommunication system, or signalling transfer points. The IP based network may also be used *inter alia* to transmit signalling information to and from Intelligent Network nodes.

Signalling information may be transmitted between said signalling points in part via a packet switched signalling network different from said IP based network, signalling information being converted from one format to another at the network interfaces. For example, said packet switched signalling network may be a common channel signalling network such as a Signalling System No.7 (SS7) based network.

In a preferred embodiment of the present invention, signalling information is transmitted between a group of locally arranged signalling points using an SS7 network.

Signalling information intended for signalling points outside the local area is transmitted to a gateway node which provides an interface between the SS7 network and the IP network. In the same way, the gateway node provides an interface for signalling information transmitted through the IP network to a local signalling point.

Preferably, the signalling data transmitted through the IP network comprises signalling information associated with call set-up and call termination in the first transmission network of the telecommunications system. Signalling information relating to call charging may also be transmitted through the IP network.

According to a second aspect of the present invention there is provided apparatus for transmitting signalling information between signalling points of a telecommunications system and which information is associated with a subscriber-to-subscriber voice or data traffic channel carried by a first transmission network, the apparatus comprising:

a IP based network forming at least part of a transmission link between said signalling points, separate from said first network; and

means for transmitting signalling information between said signalling points via the IP based network.

According to a third aspect of the present invention there is provided a gateway node for use in a telecommunications system having a first transmission network for providing a subscriber-to-subscriber voice or data traffic channel, the gateway node being arranged in use to couple signalling information, associated with said traffic channel, between a signalling network of the telecommunications system and a IP based network separate from said first transmission network.

The gateway node of the present invention may be integrated into a switching exchange (STN) of the telecommunications system. Alternatively, the gateway node may be a standalone unit, coupled to at least one exchange.

According to a fourth aspect of the present invention there is provided a method of converting signalling information from a Signalling System No.7 (SS7) protocol to a IP protocol, the method comprising:

receiving signalling messages in said Signalling System No.7 protocol from an SS7 network;

processing each received message through the signalling data link interface and requirements and the signalling link function layers of the SS7 protocol;

applying the output of the signalling link function layer to the IP protocol layers; and

transmitting the output of the IP layers over a IP network.

According to a fifth aspect of the present invention there is provided a method of converting signalling information from an IP protocol to a Signalling System No.7 (SS7) protocol, the method comprising:

receiving signalling messages in said IP protocol from a IP network;

processing each received message through the IP protocol layers;

applying the output of the IP protocol layers to the signalling link function and signalling data link interface and requirements layers of the SS7 protocol suite; and

transmitting the output of the signalling data link interface and requirements layer over a SS7 network.

Preferably, in passing a signalling massage from the SS7 layers to the IP layers, a parameter is added to the message which indicates the number of octets contained in the packet. In this way, several messages may be included in single IP datagram. Correspondingly, when a signalling message is passed from the IP layers to the SS7 layers, the same parameter is removed from the message.

Brief Description of the Drawings

For a better understanding of the present invention and in order to show how the same may be carried into effect reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 illustrates schematically a telecommunications system comprising two interconnected telecommunications networks;

Figure 2 illustrates schematically the signal processing layers of the SS7 protocol;

Figure 3 illustrates the processing layers present at a gateway node of the system of Figure 1;

Figure 4 illustrates the flow of signalling associated with call set up and termination in the system of Figure 1; and

Figure 5 is a flow diagram illustrating the signalling process employed in the system of Figure 1.

Detailed Description of Certain Embodiments

A telecommunications system in which the present invention may be employed typically comprises one or more interconnected telecommunications networks. These networks may make use of the same telecommunications protocols (e.g. ISDN, PSTN, PLMN) or may use different protocols. In addition, the networks may be operated by the same or by different operators. However, the

networks have in common that they use Signalling System No.7 for communicating signalling information between internally located signalling points (SP).

Considering Figure 1, this illustrates a much simplified telecommunications system comprising only two telecommunications networks 1,2. Both of these networks 1,2 are assumed to be Integrated Digital Services Networks (ISDN). Each network comprises a number of switching exchanges 3 interconnected by trunk lines 4. In addition, a trunk line 5 provides a link between exchanges 3 of the two networks 1,2.

In order to connect a call, placed from a first subscriber telephone 6 (A-subscriber) to a second subscriber telephone 7 (B-subscriber) connected to local exchanges of the respective networks, it is necessary for the system to reserve a traffic channel between each of the four illustrated exchanges 4, using the trunk lines 4,5. Each traffic channel is a circuit switched channel, i.e. comprising a reserved time slot in each consecutive transmission frame, and as such the network through which a call is routed is referred to here as a "circuit-switched network".

As already mentioned above, conventionally, the interexchange signalling required to set up the various circuit switched channels is conveyed by SS7. In the system of Figure 1, an SS7 network 8 is provided in each of the telecommunications networks 1,2. Each SS7 network 8 handles the flow of signalling information between signalling points (e.g. exchanges 3) of the associated network. Signalling information may be routed directly between two signalling end points, or it may be routed through intermediate Signalling Transfer Points (STP) 9. It will be appreciated that although

the SS7 networks are illustrated in Figure 1 as being distinct from the circuit switched network, the SS7 networks may make use of the trunk lines 4 for transmitting signalling data, and that the STPs 9 may be associated with respective exchanges 3.

Each of the networks 1,2 comprises a gateway node 10,11 which provides an interface for the SS7 network 8 to an IP network 11. It is noted here that the term "IP network" is intended to include networks utilising the current *de facto* IP standard as defined by the Internet Engineering Taskforce or a future derivative thereof (including the TCP or UDP protocol layers). The network 11 may be a closed network under the control of the telecommunications network operator(s), i.e. an intranet, or an open network accessible through the World Wide Web (i.e. the Internet). In either case, the substitution of the IP network for a significant part of the SS7 network provides a number of significant advantages, chiefly a reduction in the signalling traffic and processing required in the conventional telecommunications network and replacement of expensive, dedicated telecommunications infrastructure with low cost, flexible datacom infrastructure.

For each of the networks 1,2, the gateway node 10 is coupled on the one side to the TCP/IP network 11, and on the other side to STPs 9 of the SS7 network 8. Whilst the gateway node 10 may be connected to every STP 9 of the SS7 network 8, it is preferred that connection is made to only a subset of all STPs 9 of the SS7 network 8, such that signalling information to be transmitted between a give STP 9 and the gateway node 10 may require routing through one or more intermediate STPs 9.

It will be appreciated that signalling information to be transmitted from a signalling point of one network 1,2, to a signalling point of the other network, through the TCP/IP network 11, requires protocol conversion at both of the gateway nodes 10. More particularly, it is necessary to process signalling messages such that the physical message construction, and associated error detection and correction processes etc, are appropriate for the medium over which the message is next to be transmitted.

Figure 2 illustrates the seven layers (or levels) which compose the SS7 protocol. These layers will not be described here in detail, but rather the reader should make reference to the ITU-T recommendations starting with Q.700. It is sufficient here to note that layers 1 to 3 provide the physical, datalink, and network layers, whilst layers 4 to 7 provide user parts and application parts which are generally network specific (in particular, the TCAP provides transaction capabilities for services such as INAP, MAP, OMAP, etc).

Figure 3 illustrates the processing layers which are provided at the gateway node 10 in order to provide for the conversion of signalling messages between the SS7 protocol and the TCP/IP protocol. On the SS7 network side of the interface, there is provided the MTP of the SS7 protocol, whilst on the TCP/IP side the MTP is replaced by TCP/IP protocol layers. Signalling messages received at the gateway node 10 from the SS7 network 8 are thus processed through the MTP to retrieve the signalling information originally generated within an SP of the SS7 network by a user part.

At the gateway node 10, this user part generated data is passed by the MTP to an intermediate processing layer (identified by reference numeral 12). This layer 12

adds to each signalling message a header (9bits) indicating the number of octets which the message contains. The processed messages are then passed to the TCP/IP protocol layers where they is organised for transmission over the TCP/IP network 11. A single TCP/IP datagram may contain several signalling messages, such that the datagram has the structure illustrated in Table 1 below, and where SIF is the Signalling Information Field and SIO is the Signalling Information Octet.

In the same way, when signalling data is received at a gateway node 10 from the TCP/IP network 11, the signalling information is processed through the TCP/IP layers to recover the user part generated data, with the signalling message length header being removed in the intermediate layer 12, before passing the data to the MTP in preparation for transmission over the SS7 network 8.

It is noted that Figure 3 illustrates a user part(s) layer above the MTP and TCP/IP layers. However, this layer is not normally utilised in the gateway node unless the node is directly connected to a switching exchange 4 such that signalling information can be passed directly from the user parts (e.g. TUP, ISUP, etc) to the TCP/IP layers and *vice versa*.

~~It will also be appreciated that whilst signalling~~ messages are routed in the SS7 network using SS7 Point Codes, messages in the IP network are routed using IP addresses. Gateway nodes may therefore be provided with a database mapping point codes to IP addresses, using dynamic updating if necessary.

Figure 4 illustrates the flow of signalling information associated with set up and termination of a call between the two telephones 6,7 of Figure 1, where the signalling points are identified using the same symbols as are used in Figure 1. Figure 5 is a flow diagram illustrating the signalling process described above.

It will be appreciated by the person of skill in the art that modifications may be made to the above described embodiments without departing from the scope of the present invention. For example, whilst the user voice or data channel has been described above as being a circuit switched channel (E.1/T.1), this channel may be provided, in whole or in part, by a packet switched channel, e.g. where the call is made from or to a mobile telephone registered with a mobile network utilising the proposed General Packet Radio Service (GSM phase 2+).

IP header			
TCP header			
Octets, 9bits	Spare, 7bits	SIO, 8bits	SIF
8n (2=>n=>272			
:			
Octets, 9bits	Spare, 7bits	SIO, 8bits	SIF
8n (2=>n=>272			
SIF cont.			

Table 1

Claims

1. A method of transmitting signalling information between signalling points of a telecommunications system, said signalling information being associated with a subscriber-to-subscriber voice or data traffic channel carried by a first transmission network, the method comprising transmitting signalling information between said signalling points via a IP based network which is separate from said first transmission network.

2. A method according to claim 1, wherein said first transmission network is a circuit switched network.

3. A method according to any one of the preceding claims, wherein said signalling points between which the user call information and the signalling information is transmitted are switching points of the telecommunication system.

4. A method according to any one of the preceding claims and comprising transmitting signalling information between said signalling points in part via a packet switched signalling network different from said IP based network, signalling information being converted from one format to another at the signalling network interfaces.

5. A method according to claim 4, wherein said packet switched signalling network is Signalling System No.7 (SS7) based network.

6. A method according to claim 5 and comprising transmitting signalling information between a group of locally arranged signalling points using an SS7 network, whilst transmitting signalling information intended for

signalling points outside the local area to a gateway node which provides an interface between the SS7 network and the IP network.

7. A method according to any one of the preceding claims, wherein the signalling data transmitted through the IP network comprises signalling information associated with call set-up and call termination in the first transmission network of the telecommunications system.

8. Apparatus for transmitting signalling information between signalling points of a telecommunications system and which information is associated with a subscriber-to-subscriber voice or data traffic channel carried by a first transmission network, the apparatus comprising:

a IP based network forming at least part of a transmission link between said signalling points, separate from said first network; and

means for transmitting signalling information between said signalling points via the IP based network.

9. A gateway node for use in a telecommunications system having a first transmission network for providing a subscriber-to-subscriber voice or data traffic channel, the gateway node being arranged in use to couple signalling information, associated with said traffic channel, between a signalling network of the telecommunications system and a IP based network separate from said first transmission network.

10. A method of converting signalling information from a Signalling System No.7 (SS7) protocol to a IP protocol, the method comprising:

receiving signalling messages in said Signalling System No.7 protocol from an SS7 network;

processing each received message through the signalling data link interface and requirements and the signalling link function layers of the SS7 protocol suite;

applying the output of the signalling link function layer to the IP protocol layers; and

transmitting the output of the IP layers over a IP network.

11. A method according to claim 10 and comprising adding a message length parameter to each signalling massage output from the SS7 layers prior to passing the messages to the IP layers, said parameter indicating the length of the associated signalling message.

12. A method of converting signalling information from a IP protocol to a Signalling System No.7 (SS7) protocol, the method comprising:

receiving signalling messages in said IP protocol from a IP network;

processing each received message through the IP protocol layers;

applying the output of the IP protocol layers to the signalling link function and signalling data link interface and requirements layers of the SS7 protocol; and

transmitting the output of the signalling data link interface and requirements layer over a SS7 network.

Abstract (57)
A method of transmitting signalling information between signalling points (3,9) of a telecommunications system, the signalling information being associated with a subscriber-to-subscriber (6,7) voice or data traffic channel carried by a circuit switched channel transmission network (1,2). The method comprises transmitting signalling information between said signalling points (3,9) via a TCP/IP network (11) which is separate from the circuit switched channel transmission network.

Fig. 1

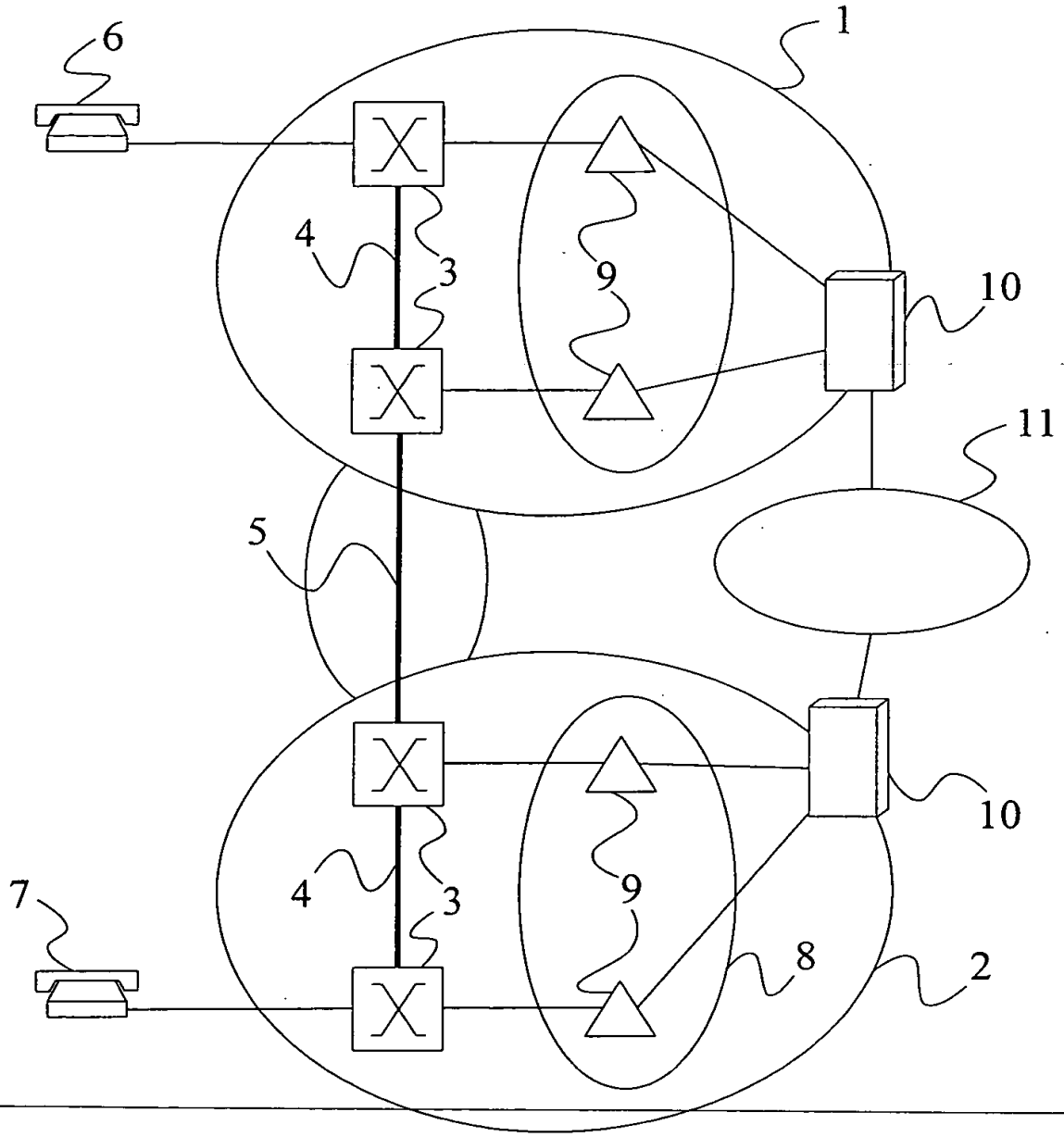

Figure 1

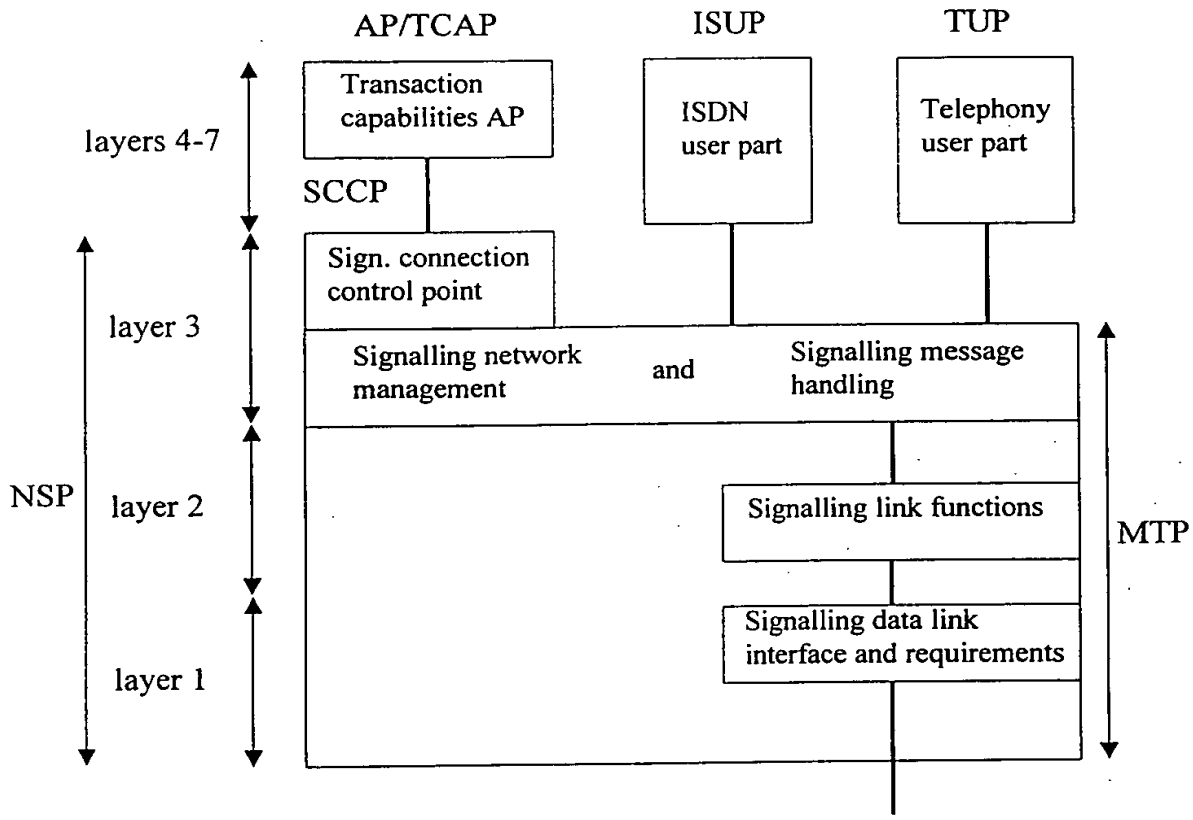

Figure 2

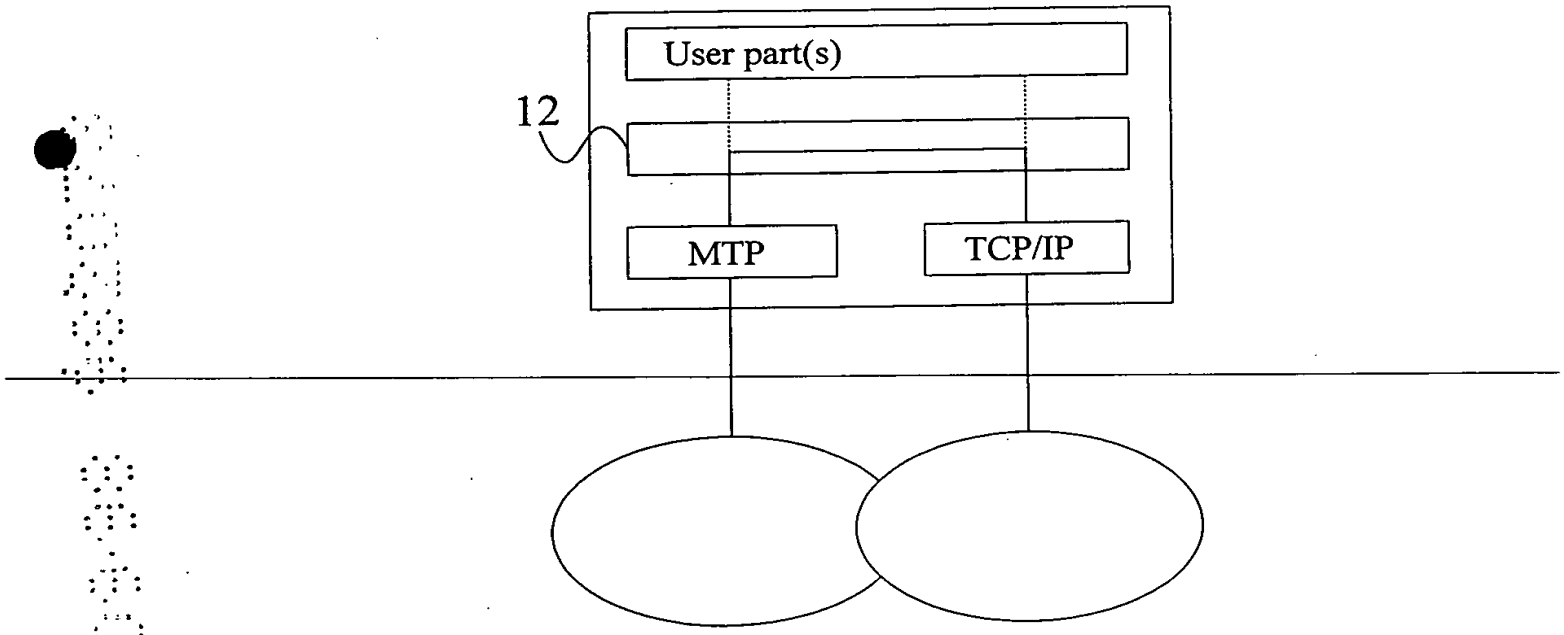

Figure 3

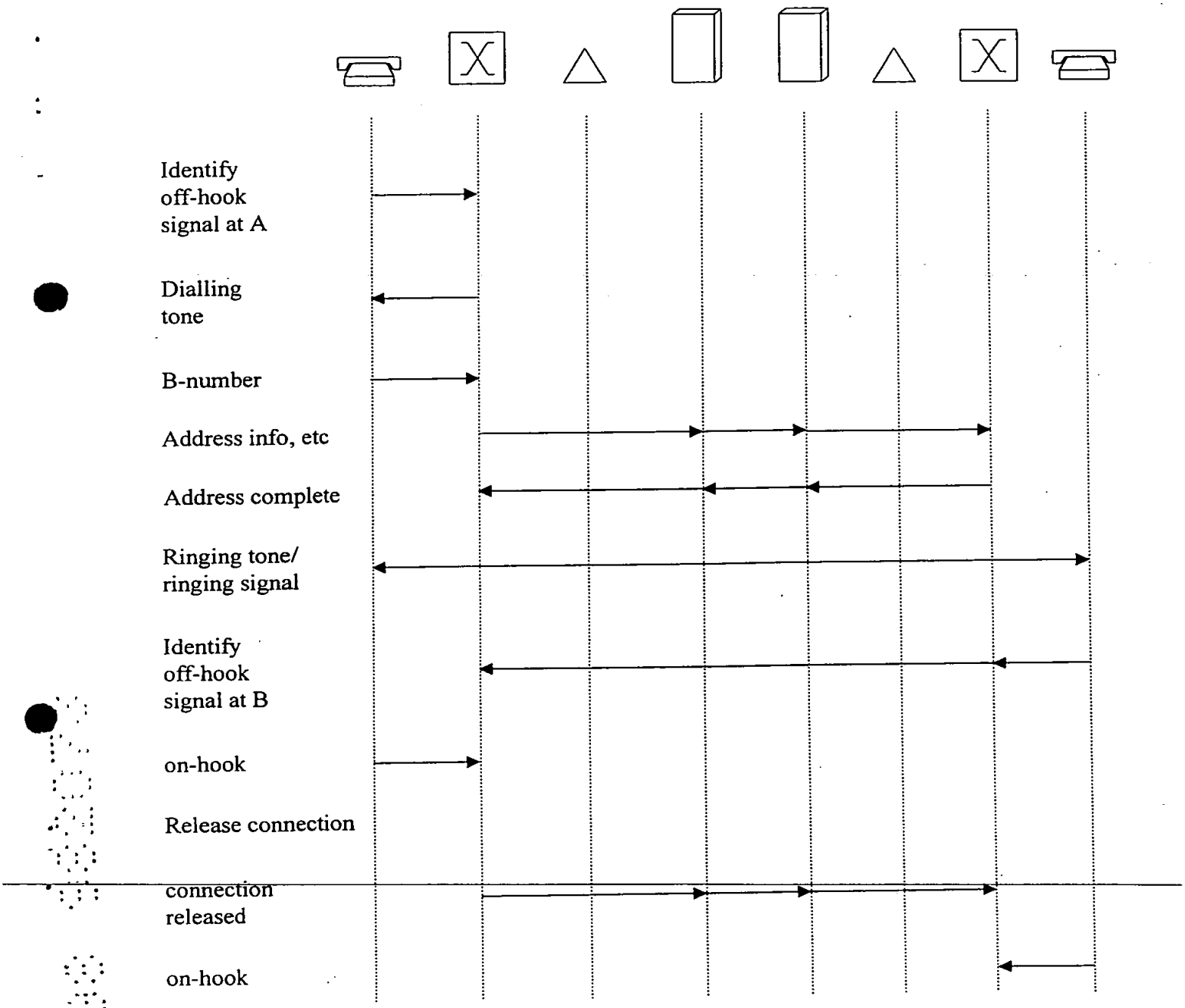
Identify
off-hook
signal at A
Dialling
tone
B-number
Address info, etc
Address complete
Ringing tone/
ringing signal
Identify
off-hook
signal at B
on-hook
Release connection
connection
released
on-hook

Figure 4

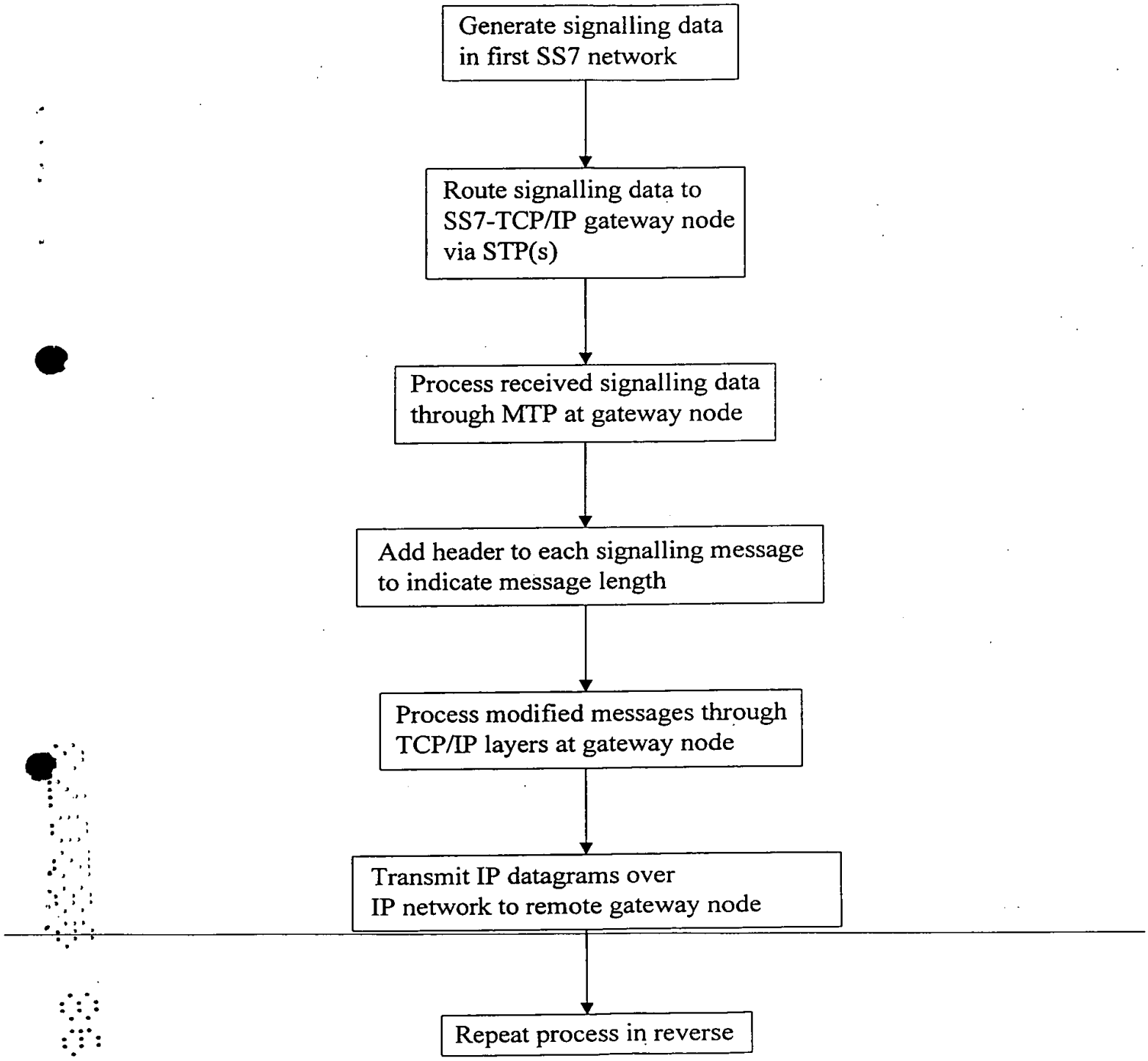
Generate signalling data in first SS7 network
Route signalling data to SS7-TCP/IP gateway node via STP(s)
Process received signalling data through MTP at gateway node
Add header to each signalling message to indicate message length
Process modified messages through TCP/IP layers at gateway node
Transmit IP datagrams over IP network to remote gateway node
Repeat process in reverse

Figure 5